

# Final report

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## Environmental credentials for Australian beef - Drought Resilience theme

Project code: L.SFP.1006

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## **Abstract**

This project contributes the drought resilience theme for the Environmental Credentials for Australian Beef project, which is developing a single online platform for grassfed beef producers to demonstrate sustainability to their markets using remote sensing and additional information. The methodology comprised a desk review for background scoping research, a series of co-design working groups, and synthesis of their deliberations and team investigations into a design brief. The producers defined drought resilience in an integrated way, as involving the resilience of their land, their business and themselves and family. Building resilience includes a cyclical approach of planning in good times, through to coping with a drought, recovery and learning from it. The producers seek a planning and awareness tool, associated with learning resources, designed to enhance practice. Further, there is opportunity to present evidence to banks, and to government departments that require demonstration of a drought plan among eligibility criteria for access to drought relief programs. Industry benefits include the opportunity to participate intensively in designing technology to suit their own needs, the resilience focus, and the prospect of a tool and learning resources to enhance their management.

## **Executive summary**

### **Background**

### **Objectives**

The project objectives are to:

- Develop the design brief for the drought resilience theme for the Environmental Credentials for Australian Beef (Smart Farms) project ready for translation into an online platform. Theme design will include indicators, measuring tools/approaches, benchmarks and learning resources. The platform design must be suitable for producer self-assessment of environmental performance.
- Support the environmental credentials platform developer in integrating the drought resilience theme into the online platform.

### **Methodology**

The project methodology comprised:

- Desk analysis to prepare a scoping paper - to provide background information for theme development then for the co-design working group participants with the beef producers and value chain players
- Co-design workshops with the beef producers and value chain players
- Preparation of a design brief
- Meetings with platform builders to support their role.

### **Results/key findings**

The project produced a design brief, informed by co-design, for a user-friendly drought theme that enables producers to query information about their property; to assess their drought risks with respect to their land, their enterprise and themselves; and key indicators of how well their land use management is positioned to provide resilience to those risks.

Producers seek an online tool that will help them to:

- Understand what resilience involves, and what planning is required of them in order to become more resilient to droughts
- Understand the different facets of drought
- Understand and work in an integrated way towards building the resilience of their land, their business and themselves and family. This includes a cyclical approach of planning in good times, through to coping with a drought, recovery and learning from it
- Use indicators and measures for land condition, land management, enterprise management and individual/family resilience to assess drought readiness and monitor progress at all stages in the cycle
- Demonstrate their drought planning and management performance to relevant organisations, should they so wish.

## **Benefits to industry**

The drought resilience theme, within the platform is valuable to the Australian beef producers for improving their drought resilience and sustainability outcomes. The platform is a useful tool for assessing, planning and improving drought management by the producers. It helps the producers as a tool to present their drought resilience status to relevant government departments as well as to the banks for assessing the drought risk management of their clients.

## **Future research and recommendations**

Further research will be useful on:

- Evaluation of the platform some time after release
- Research on market demand
- Research on verification and certification
- Expansion to other agricultural industries

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## 1. Background

Customers and other industry stakeholders are increasingly looking for evidence of sustainable production practices. A challenge for beef producers is how to demonstrate their environmental performance without dependence on costly on-ground audits, and achieve recognition without shared standards and reporting systems. A common platform requires a coordinated approach, otherwise fragmented best management approaches and market schemes will continue to persist. Using a co-design process that directly engages stakeholders, the Environmental Credentials for Australian Beef Project (L.SFP.1000) is developing a national, common platform that allows producers to assess their environmental performance and voluntarily demonstrate their environmental credentials to markets. The project was funded by the Commonwealth Government under its Smart Farming Partnership and implemented by a Consortium of three organisations: Meat and Livestock Australia, WWF-Australia and The University of Queensland. The national platform will ensure a single set of outcome-based standards, use remote data sources (e.g., satellite imagery) for verification of sustainability credentials (where possible) and provide a solution for producers wishing to demonstrate their environmental performance against five themes: tree cover, ground cover, biodiversity stewardship, carbon balance and drought resilience. These themes will combine into one online platform for grassfed beef producers that offers a variety of options to assess, demonstrate, and learn more about how to improve sustainability (and for drought, resilience) on their property and in their production system.

The drought resilience theme, conducted by The University of Queensland, will support producers to anticipate droughts and to manage well in order to cope with and recover from droughts. To do this we aim to provide grassfed beef producers with an information and verification base, and learning resources, to support sound planning and management strategies for drought resilience, before, during, and in recovery.

The drought resilience team is Prof. Helen Ross (Theme Lead, resilience expert), Prof. Kim Bryceson (expertise in drought, remote sensing, e-agribusiness), Dr Salman Sarwar (expertise in drought, beef industry, remote sensing), Dr Severine van Bommel (expertise in co-design) and Ms Tarni Cooper (expertise in beef industry, assistant).

There is a major difference between drought resilience and the other four themes in the project, which have clear markets to which to demonstrate their environmental sustainability performance. The drought resilience theme is far more about awareness and self-help, while obviously having implications for producer and industry financial viability and for environmental sustainability and resilience. Thus, while the other themes seek to enhance market access through demonstrating good environmental management, drought resilience is arguably oriented more to avoiding permanent or long-term damage to the land, while simultaneously keeping the land, the enterprise and the people resilient enough to carry on sustainably after a drought. As the co-design group members (see below), argued, while there might not be a clear 'market' for drought resilience, it is a precondition for being positioned to meet any of the other credentials represented in the platform. Thus, relevant information and features of the drought resilience theme are shared with other themes, so that all the work combines to produce one linked platform that serves multiple purposes.

This theme needs to be considered in the context that there are various tools and resources already available on drought assessment, some national and some restricted to specific states or regions. Most of these are focused on *drought* information or decision support, not *drought resilience* information or *resilience-building* strategies. There is a currently a challenge for a user seeking to be informed and to manage towards achieving drought resilience, to locate, navigate and make choices

among these many fragmented resources, and derive value from using them in combination. With a few exceptions (discussed below), there is limited support available to producers to consider drought *resilience*, and to manage their lands, enterprises and selves accordingly. This is in the context that most industry information is presented towards managing land and enterprises productively and profitably, and increasingly sustainably, but not yet with a view to resilience.

In this document, we use the term ‘platform’ to refer to the overall product to be developed by the Environmental Credentials for Australian Beef project, which includes all five themes. We refer to the drought resilience ‘theme’ in that context.

## **2. Objectives**

All the objectives have been achieved. Table 1 lists the objectives and the progress.

**Table 1 Status of project objectives**

Objective	Status
<p>1. Develop the design brief for the drought resilience theme for the Environmental Credentials for Australian Beef (Smart Farms) project ready for translation into an online platform. Theme design will include indicators, measuring tools/approaches, benchmarks and learning resources. The platform design must be suitable for producer self-assessment of environmental performance. The process to achieve this will include:</p> <ul style="list-style-type: none"> <li>a) Delivery of a desktop review of existing policies, government and industry schemes, standards or similar learning resources, programs, and measures relevant to the drought resilience theme. Deliverable will be an issues scoping paper summarising existing knowledge, learning programs and resources, indicators and measures.</li> <li>b) Coordinate and manage up to five co-design sessions with beef producers and relevant industry and other stakeholders to identify the scope and design of the solution.</li> <li>c) Facilitate technical peer review of the proposed drought resilience theme before it is finalised by the co-design working group.</li> <li>d) Select, collate, review and update relevant drought resilience theme materials for inclusion in the online platform, and incorporate co-design working group and technical peer review feedback into the drought theme design brief.</li> <li>e) Produce a design brief for the technical builder of the online platform, from the co-design process. Design brief to cover (minimum): <ul style="list-style-type: none"> <li>i) technical brief including any remote sensing or decision support component requirements</li> <li>ii) brief for online learning.</li> </ul> </li> </ul>	<p>Achieved. Desktop review/ scoping study completed and delivered in August 2021.</p> <p>Achieved. Seven co-design working group meetings were conducted between October 2021 and March 2022.</p> <p>Achieved. Theme design and output was peer reviewed by panel of external experts in June – July 2022.</p> <p>Achieved.</p> <p>Achieved. The design brief was completed and delivered in July 2022.</p> <p>Achieved.</p>
<p>2. Support the environmental credentials platform developer in integrating the drought resilience theme into the online platform.</p>	<p>Achieved.</p> <p>Theme scope provided to platform developer. Meetings have continued and the team continues to supply further information and give feedback, as required.</p>



### 3. Methodology

The project methodology comprised a desk analysis, reported as a scoping paper; conducting an intensive co-design process; and synthesis of working group deliberations supplemented by further team investigations into a 'design brief'. Further research continued to elaborate information towards the 'drought resilience index' (see section 4.2.4). Follow-up meetings with the platform builders will continue to the end of the project.

#### 3.1 Desk analysis

A comprehensive desk analysis was conducted to explore the scope and meaning of the topics 'drought' and 'resilience', and identify and summarise the existing knowledge, indicators and measures, learning tools and resources (both existing and in development) that have linkages to drought resilience. The resulting scoping paper laid the basis for the theme. It provided background information to the Project Consortium (i.e. MLA, UQ and WWF) and later the co-design group. The scoping paper was peer reviewed.

#### 3.2 Co-design workshops with producers

Eight producers were recruited to participate in the co-design process, from those who expressed interest in a national call through MLA's networks. They were selected to cover all beef regions (so far as possible), varying sizes of enterprise, and to ensure gender balance. While the other themes included (usually) two value chain representatives each, this was not so relevant to the drought resilience theme. All members participated on a voluntary basis, and were paid an honorarium for meeting times, at MLA rates.

The detailed approach for the co-design process is explained in the co-design scoping paper (milestone 1 report, see appendix 3) and the co-design final report (Cooper et al. 2022). There were only minor modifications to that design. The first was adoption of a flipped learning approach (by all themes) so that producers prepared from materials supplied before each meeting, and the meeting was able to concentrate on discussion without need for presentations (only brief summaries and reminders). We decided to make the meetings shorter, 90 minutes rather than three hours, to avoid fatigue in online meetings and to take advantage of the flipped learning approach. Consequently we held seven rather than the five meetings originally planned. The other themes moved from 90 minute to two-hour meetings during the series, but the drought resilience theme held to 90-minute meetings (and conducted seven of these). This translated to 10.5 hours of actual meeting time. At the end of the series of meetings, a webinar was held to share the findings of all themes with all interested participants, and encourage further comment.

The topics for each meeting were partly driven by the participants' interests (e.g. how widely to set the scope of 'resilience'), and partly by contract requirements (e.g. to specify indicators and measures).

Prior to each working group meeting, the project team prepared a briefing for the participants, drawn from the scoping paper and some new information. After consultation with the independent facilitator, and asking group members how they like to receive material (e.g., as a written document or as a recording), the information was provided in both forms. The recordings were placed on a private YouTube channel. For some meetings members were also provided with links to specific tools and learning resources (existing and under development), and they were asked to trial them.

The preparation of materials involved a further review of tools (subsequent to the scoping paper, see appendix 3) and a review of learning resources. See appendices 1 and 2 for a full list of tools and learning resources reviewed and presented to the participants.

The meetings were organised by the theme lead. They were co-facilitated by an independent facilitator with experience in online facilitation, a member of the co-design team and the theme lead. All were held on the Zoom platform, and recorded. After each meeting, an assistant and the theme lead compiled detailed notes for the participants' and project use. Each of these documents ended with a summary of progress to date on developing the definition and scope, indicators and measures, benchmarks and learning resources. Participants were given opportunity to comment on these short reports and seek any corrections at the following meeting. The lead facilitator conducted short evaluations at the end of each meeting, by Zoom poll or by asking brief questions of each participant in turn. The co-design process was evaluated by an independent consultant (Coutts 2023). A final evaluation of the entire project was also conducted through the webinar held at the end of the series of co-design meetings.

The drought resilience working group meetings were conducted between October 2021 and March 2022. Over the series of meetings the working group members discussed the scope of the topic of 'drought resilience', the main features they sought in the platform, and specific indicators and measures. In the course of preparation and discussion they reviewed and gave reactions to a number of the existing tools and learning resources to identify their strengths, weaknesses and potential synergies. They also considered whether a drought resilience theme was appropriate and useful within the overall project, given the existence of some platforms and tools which appeared to cover parts of the need.

Table 2 shows the timing and purpose of all meetings of the drought resilience theme co-design group.

**Table 2 Summary of drought resilience theme co-design group meetings**

Meeting number	Meeting date	Purpose of the meeting
1	12/10/2021	<ul style="list-style-type: none"> <li>• To provide an overview of the project</li> <li>• To get to know each other (backgrounds, motivations, knowledge, skills)</li> <li>• To negotiate ground rules</li> <li>• To understand working group members hopes and concerns regarding the project</li> </ul>
2	26/10/2021	<ul style="list-style-type: none"> <li>• To orient to the drought theme</li> <li>• To ensure understanding and agreement on the working group's task/scope</li> <li>• To build perspectives on how this theme could be valuable (a work in progress)</li> <li>• To consider the types of resilience the theme might cover</li> </ul>
3	23/11/2021	<ul style="list-style-type: none"> <li>• To share comments on tools the WG members have studied</li> <li>• To consider what a tool we build might offer</li> </ul>
4	7/12/2021	<ul style="list-style-type: none"> <li>• Become familiar with the concepts of 'indicator' and 'measure', and those available for drought</li> <li>• Discuss which would suit their preferred purposes in terms of planning/preparation for drought, i.e. close link to management; and any verification.</li> <li>• Consider whether, and how, this could link to subscription-based tools some producers pay to use</li> <li>• Indicators for business and personal resilience.</li> </ul>
5	25/1/2022	<ul style="list-style-type: none"> <li>• Review and confirm – current status of the project. Discuss Drought Resilience -Self Assessment Tool (DR-SAT) and other contexts</li> <li>• Explore the possibilities in business and personal, family, community resilience indicators and measures, and how these could sit with the proposed platform and DR-SAT.</li> </ul>
6	15/2/2022	<ul style="list-style-type: none"> <li>• Briefly share information on the other project themes, their progress and directions</li> <li>• Sharpen focus on the 'verification' opportunities in this theme</li> <li>• Focus on the learning resources component to clarify purposes, consider topics, styles of material, user levels (e.g. beginner, advanced) and review promising existing resources, and how to incorporate emerging initiatives</li> </ul>
7	8/3/2022	<ul style="list-style-type: none"> <li>• Overview of platform design, other themes</li> <li>• Summary (brief) of drought resilience theme key features</li> <li>• Discussion of scorecard concept (now termed index) and content</li> <li>• Feedback on experience of this co-design process.</li> </ul>

### 3.3 Preparation of design brief

A design brief was synthesised based on the deliberations of co-design working group, supplemented by team investigations which contributed to its refinement. This completed the collaborative co-design process (co-design milestone report 2) with the working group members. From this point, the theme's work was deemed complete, other than providing ongoing advice and support to the platform developers as and when required.

### 3.4 Follow-up meetings with platform builders

Subsequent to completion of the design brief, the team is continuing discussions with the platform builders to clarify aspects of the design brief, elaborate detail on the proposed drought resilience index, and give feedback on the platform builders' proposals as required.

## 4. Results

The key findings and results of the project are presented in three main sections. First, we explain the desk analysis and the resulting scoping paper. Next, we discuss the results from the seven co-design sessions. Finally, we present a summary of the design brief which documents instructions and the materials for the developers for inclusion in the online platform.

### 4.1 Initial desk analysis

The desk analysis provided background information for the purposes of the Consortium, to help decide the scope for the theme. It later helped to inform the series of co-design working group meetings. It explored meanings and definitions of 'drought', and 'resilience', and collated and reviewed online tools available or in development relevant to the drought resilience theme.

There is no nationally agreed standard definition of drought. The Bureau of Meteorology (BOM, 2022) defines drought broadly as

*A long period of abnormally low rainfall, especially one that adversely affects agriculture and other human activities.*

The Bureau lists four related types of drought:

- Meteorological drought – rainfall deficiency
- Hydrological drought – reduced river levels, water in storages, soil moisture
- Agricultural drought – reduced productivity, lost income, strain on the agricultural community
- Socio-economic drought – when effects spread through the wider community.

Most tools are generic to all types of farming, not specific to beef producers though they appear to serve their needs. Very few of these are national, most are for specific states or regions, particularly Northern Australia.

Meanwhile there are many good drought (but not resilience) assessment tools, on a range of specific topics. Much of what exists or is in development either deals with 'drought' with respect to climate and weather predictions, or maps the landscape using various indicators. While these tools can be informative about drought, they do not necessarily help with the essential aspect of resilience – withstanding shocks. One of the challenges for a producer is which to choose, while avoiding being overwhelmed.

### 4.2 Co-design working group results

The co-design process led to decisions about the definition and scope of drought resilience, indicators, measuring tools/approaches, benchmarks and learning resources. The members

recognised variation in regions and in types of production (e.g. fattening vs breeding foci) and many other reasons for diversity among producers. These findings are summarised in the sections below.

#### 4.2.1 Definitions

After considering existing definitions (see 4.1), the working group defined drought resilience for this project's purposes as:

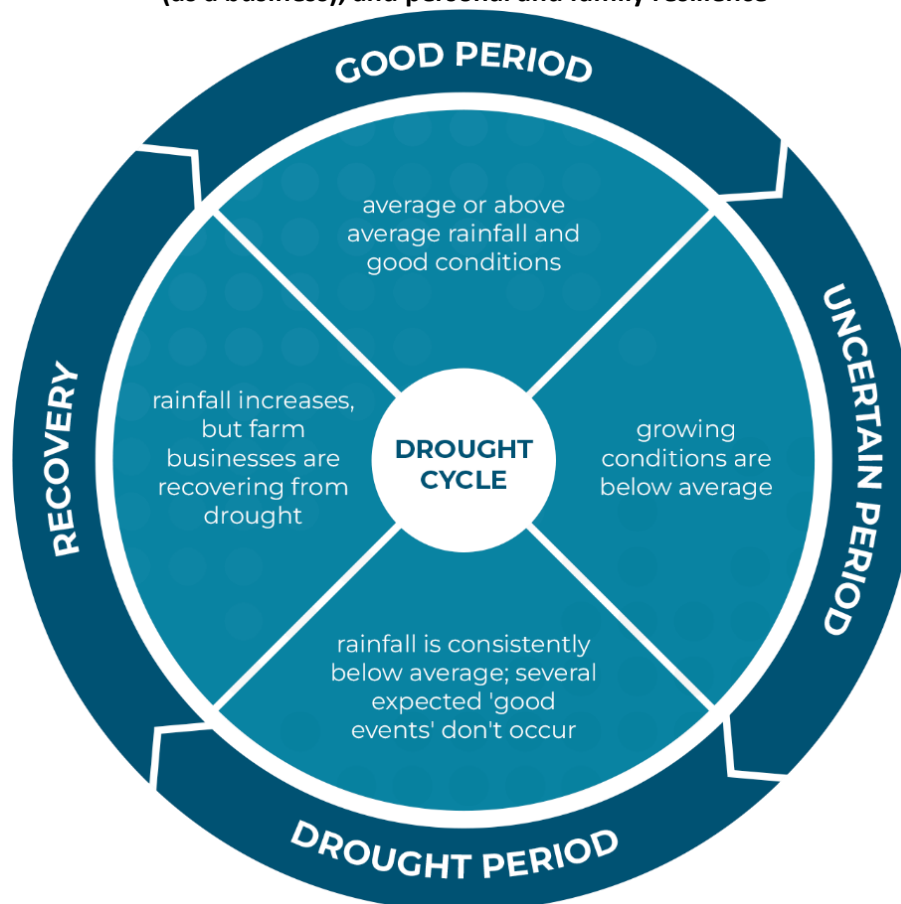
*the ability for land, livestock, enterprise and people to prepare for and adapt successfully when faced with droughts and related challenges. Land, enterprise and personal resilience are closely inter-related.*

#### 4.2.2 Scope

After much discussion across several meetings, the working group (and drought resilience team) decided that they would like the platform to encompass the *resilience of their land, their financial and enterprise resilience, and personal resilience* for themselves and family. They see these as closely inter-related, with each influencing the others. This integration creates a unique opportunity to improve on existing resources to add considerable value for producers.

The platform would cater for all stages of a drought cycle (see Fig. 1), with particular emphasis on the preparation in 'good times' in order to be most resilient during and following droughts.

**Figure 1 Stages of the drought cycle matched to producer activities, for their land, their enterprise (as a business), and personal and family resilience**



Source: Victorian Drought and Innovation Hub <https://vicdroughthub.org.au/resources/stages-of-drought>

### **4.2.3 Review of existing tools and projects in development**

The set of existing tools and those in development was updated for consideration by the co-design working group. These are listed in Appendix 1. In testing a number of these in preparation for meetings, members of the working group reported that none met their expectations, though the set of existing online tools provides some options for incorporation in our platform. They commented on features that appealed to them.

### **4.2.4 Indicators and measures**

The platform would include a suite of indicators and measures for measuring, monitoring and improving drought resilience. The following set separates indicators of drought, i.e. the stress (meteorological and hydrological drought) to which producers and their land must be resilient, from indicators of resilience to drought.

#### **Drought indicators**

The working group proposed:

- Rolling rainfall indicators rather than annual rainfall (the group suggest a traffic light system to warn of dryer conditions)
- Seasonal forecasts; or 4, 6, and 12-month forecasts
- Rainfall deciles
- Follow up rainfall, not just breaking rainfall
- Spoiling rain\*.

The team introduced the working group to two combined drought indicators, the Australian Combined Drought Indicator (national) and the NSW Combined Drought Indicator (each combining slightly different measures). Details of these are in the theme scoping paper (Appendix 3).

#### **Drought resilience indicators**

The working group examined a wide range of resilience indicators. These are grouped into the categories we propose using in a drought resilience index.

##### **1. Land resilience**

Land that is stretched beyond its capacity, especially by over-grazing, a common feature in drought, may never recover, or take many years to do so. This reduces future production potential.

Indicators would be useful for:

- Ground cover, tree cover (both included elsewhere on the platform). At this point, the measures available remotely are ground cover, and estimate of feed on offer after tree cover has been deducted from that number. There is no known way to detect pasture quality at this point
- Soil types
- Water holding capacity

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\* Spoiling rain in winter causes damage to tropical pastures, leading to a reduction in diet quality.

- Water availability (bores, dams) – plant-available water at autumn and spring break
- Ideally percentage weed cover would be included but this technology is not available by remote sensing. Instead, a more qualitative measure could be included on the Drought Resilience Index
- Vegetation on-farm - pasture quantity and its quality (if practically possible through remote sensing).

The working group members were also interested in indicators of additional stresses, i.e. frost, hail, bushfires, pasture die-back, kangaroos and grasshoppers. These are not strictly related to drought, but may interact to exacerbate the effects of a drought (e.g. reduced pasture performance, competition for feed).

This set of indicators is primarily about the land's condition (and is also informative for management decisions, see below). They need more interpretation, and help from benchmarks (showing thresholds, or danger levels) that show when, for example, ground cover is too low for the land to endure a drought without long-term damage or severe compromise to recovery.

## **2. Land management**

This set of indicators focuses on information and feedback on the resources (pasture, livestock, moisture) available to producers, supporting them to make management decisions to handle periods of drought strategically:

- Large Stock Unit (LSU), stock days per hectare<sup>†</sup> (SDH) per 100 millimetres rainfall
- Minimum ground cover target for end of drought
- Use of a Green Date (critical date for break of dry season)
- Stocking rates relative to carrying capacity
- Fodder budgeting - available food going into winter and spring.

Useful measures all aim to suggest how to match feed demand with supply, but the desired levels vary depending on property type, management practices and location.

## **3. Enterprise/business resilience**

Resilience of the enterprise, or business, relates to the entity's ability to withstand a drought. Key factors in this form of resilience are planning, having multiple sources of income, and having financial reserves. These enable an enterprise to think ahead, and adapt strategy as required.

- Having a drought management plan
- Income diversification on-farm/off-farm
- Financial reserves.

## **4. Personal and family resilience**

Personal resilience affects how well an individual producer or family can function during periods of drought, and thus minimise personal strain and make good decisions. Drought places major stresses on mental health. Personal, family and to an extent community resilience are inter-related, in both

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<sup>†</sup> the number of large stock units that can graze for one day on one hectare of land.

supportive ways and creating negative spirals. While many indicators and some psychologically tested scales are available (but few are available publicly or free of charge), the working groups agreed the most relevant indicators are:

- Stress levels
- Optimism
- Empowerment.

### **Drought Resilience Index**

Rather than solely offer indicators and measures as maps and lists (or similar), the team and working group proposed combining the indicators (and measures) into a ‘Drought Resilience Index’<sup>‡</sup> as a planning and learning resource at each stage of the drought cycle (it could, with caution, also highlight nearness to thresholds, if we can identify suitable thresholds). The index is proposed to be a self-assessment tool partially, which links to a tailored suite of learning resources. Values in good times would provide a baseline to compare with during and emerging from droughts, but use of the index could commence at any time.

The indicators and measures in the multi-dimensional index would help a producer to understand their likely resilience with respect to their land, business/enterprise and themselves, and provide an entry point for learning pathways. The index would summarise status on each of the four categories of drought resilience and management.

The approach to the personal resilience part of the index (e.g. questions asked, approach to scoring) would need to be psychologically ‘safe’. There is a strong ethical dimension to this part of the platform, but it is also useful. Well validated measures for the indicators required are available, but most are available only on a user-pays basis.

The theme team continue to work with the platform developers to elaborate the more complex indicators and measures, especially this index, and to consider the best ways of including the set of indicators and measures in the learning resources part of the platform.

### **4.2.5 Benchmarks**

The producers were most interested in comparing their scores to their own previous scores (historical benchmarking). There was also interest in comparing performance with similar other producers: in one’s region (i.e. regional benchmarking); properties of similar scale (large, small); and even some mention of types of enterprise (standard cattle production, or breeding).

A highly desirable, but difficult, type of benchmark equates to the resilience concepts of ‘thresholds’, levels of an attribute (and hence indicator) beyond which recovery is extremely difficult, if not impossible. For example, in principle there would be a level of ground cover (differing by regions, and possibly by soil type), beyond which land recovery after drought is extremely difficult, or impossible. This can be associated with a ‘danger zone’, a band of levels in which producers should be concerned and do their utmost to stay well clear of the threshold. The problem is lack of research to show what these thresholds and danger zones actually are for many of the indicators, let alone how they differ by location. With respect to ground cover, MLA guidance (MLA, 2022) suggests the

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<sup>‡</sup> In the design brief this was termed a ‘scorecard’. In discussions with the platform builders we have agreed that this term suggests that aspects of resilience could be reduced to ‘numbers’, and that that is not constructive. The intention is a combined indicator (although terminology may change). The platform builders may proceed with a different term.



threshold for low probability of recovery may be 20%, and the danger zone, approaching that threshold, begins around 40% (or higher). The Ground Cover theme is best able to identify the most valid threshold (probably at least 30% ground cover), and to ensure our categories match as closely as possible. Seventy per cent ground cover is recommended as a desired minimum level to achieve, with a higher percentage on steep slopes.

With respect to land- and management-related benchmarks, a single national benchmark would not reflect environmental or production realities. The producers are most interested in broad biogeographic/production regions, and/or natural resource management regions (Australia has 54). The minimum distinction is north and south.

#### 4.2.6 Learning resources

The participants agreed that the **purposes** of the learning resources should be to:

- make producers more aware of the types of drought, what resilience involves, and the importance of drought resilience (and engage them, explaining the utility of the learning resources)
- demonstrate possible strategies, such as options for destocking, containment feeding, diversification, maintaining a breeding herd, etc.
- encourage and support planning – for before, during and in recovery from droughts
- provide a convenient gateway (via links) to other resources e.g.
  - Counselling, financial support programs and other personal and community resilience resources
  - aspects of farm management, that are useful in, but not specific to, drought resilience e.g., financial literacy, planning, structuring
- facilitate peer-to-peer learning through producer presentations and case studies.

The working group sees improvement of performance as the primary role of this theme; all producers need to prepare well for droughts. That means they need to be convinced of the value of doing so, then offered good information for planning, and strategies. This means that where the other themes will appeal most to the most proactive producers, this theme is of highest value to the less aware. It should also bring interest and support to proactive producers; working group members say they are keen to learn and improve too.

The working group members are keen to:

- have first-hand information from other producers (people like themselves, who they can trust), hence personal and property-based case studies, recordings.
- differentiate advice by region – minimum north vs south as conditions and strategies are so different.
- have pathways from basic explanation of concepts, to beginner steps, to more advanced. Also have progression from brief pointers to more immersive experiences, e.g. the RCS course.
- have a mix of resources, some providing information, some encouraging learning by doing
- link our software to their grazing land management tools, so that they can keep adapting stocking levels to land capability. However those they advocated are available by subscription. Free stocking rate calculators are readily available, though with fewer features.

- learn how to combine drought resilience, and more generally sustainable management, strategies, with the profitability and efficiency advice they are much more usually given.
- curate the learning experience; avoid providing just a long list of links, that mean the producer gives up after a few clicks. That said, they are open to having external links, e.g. to funding sources, practical supports (e.g. counselling) that are beyond this project's scope. Links reduce the need for updates on our platform, but reduce the 'one stop shop' experience.

Meanwhile the project needs to be mindful of distressing producers in discussion and assessment of drought. It is important to be sensitive to the feelings of producers when experiencing drought. The working group and drought resilience team discussed whether the term 'dry times' should be substituted for drought (as some resources do). On balance we considered that avoiding the term 'drought' could direct attention away from the majority of existing resources, which do use the term 'drought'. Psychological 'safety' is paramount, particularly in the personal and family resilience part of the proposed platform.

The working group identified three learning resources as the most useful for potential incorporation in the platform: the RCS drought preparedness online course; the Drought Resilience Self-Assessment Tool (in development at the time); and MLA's Tools and Resources for building business resilience during dry times. The last is essentially a portal to other resources, in pdf form. It provides a very brief description of each resource but relies on the user to choose and navigate their way through the many available.

The working group was not definitive about the starting points for learning pathways, but leant towards pathways leading from our proposed drought resilience index, and/or performance. The learning section needs to have different **user levels** - entry level (unfamiliar with drought, resilience, or management strategies available) to guidance for more experienced producers who have already completed numerous basic courses and engaged with learning and are looking for more.

### 4.3 Design brief

The design brief covered the topics of definition and scope, measuring tools/approaches, benchmarks and learning resources. These are covered in sections 4.2.1 to 4.2.6 of this report. It also presented the concept and initial specifications for a 'scorecard' (now termed 'drought resilience index').

## 5. Conclusion

The drought resilience theme is one of five within an integrated online platform, Environmental Credentials for Australian Beef, alongside tree cover, ground cover, biodiversity stewardship and carbon balance. This theme aims to support Australian grassfed beef producers in anticipating and effectively managing droughts throughout the drought cycle. It takes an integrated approach to resilience, to ensure the resilience of the land, enterprise, and people. This part of the platform will provide an information base and learning resources for sound planning and management strategies towards droughts, recognising that preparation is essential before drought, and that planning and management activities need to vary during and after drought events.

The development of the drought resilience theme involved background scoping research, a series of co-design sessions involving beef producers and value chain actors, and further development by the

project team to produce a design brief for the online platform. The design brief captures the deliberations of the co-design group, supplemented by team investigations, professional judgement and reviewer advice.

This report covers the work to the point of completion of the design brief. The project team is now supporting the platform developers as they work to create the actual platform. The co-design group's intentions may be modified in some ways as the platform is designed and constructed.

While the other themes in the project focus on environmental credentials and seeking to enhance market access by demonstrating sustainability, there is little current 'market' for demonstrating drought resilience, though there is interest from state governments and banks. Drought resilience is of greatest interest to producers, who are acutely aware of the need. The drought resilience theme thus focuses on increasing awareness and enabling self-help among producers.

The co-design participants sought a user-friendly platform that allows grassfed beef producers to query information about their property, assess drought risks, and use key indicators and information about potential management strategies to improve their drought resilience. The theme takes a comprehensive view of resilience, considering resilience of the land (especially to avoid long-term damage), land management, business decisions and personal/family dimensions. In incorporating the business and social aspects, the theme recognises the interplay between different dimensions of resilience. It provides indicators and measures for each of these dimensions, designed to use remote sensing capabilities where possible, and to combine these with management indicators (such as Large Stock Unit, stock days per hectare and per 100 millimetres rainfall). Indicators of business and personal resilience must rely on the producers' inputs.

Several learnings, knowledge gaps, and resource requirements were identified. These include the need to bridge the gap between drought information and resilience-building, exploring integration with existing planning and management tools, and further cross-referencing and collaboration between themes. Additional resources, both in terms of information and tools, will be valuable to enhance the platform's effectiveness and provide comprehensive support for beef producers in building drought resilience and sustainable practices.

## **5.1 Key findings**

The producers considered drought resilience to be an important aspect of sustainability in the Australian beef industry. The recent recurring and extended droughts have highlighted the importance of drought resilience for the Australian beef industry, and that many producers need to be better prepared and resilient to survive droughts. Most producers felt that managing financial and social impacts of prolonged droughts are critical from the perspective of the long-term sustainability.

Producers seek an online tool that will help them to:

- Understand what resilience involves, and what planning is required of them in order to become more resilient to droughts
- Understand the different facets of drought
- Understand and work in an integrated towards building the resilience of their land, their business and themselves and family. This includes a cyclical approach of planning in good times, through to coping with a drought, recovery and learning from it

- Use indicators and measures for land condition, land management, enterprise management and individual/family resilience to assess drought readiness and monitor progress at all stages in the cycle.

## 5.2 Benefits to industry

The producers see high value in including drought resilience theme in the platform, and using it alongside the other themes. It offers a strong opportunity to add information and decision capacity to the resources which will be provided in any case for the other themes. Further, the drought resilience theme can enable them, if they wish, to present evidence to banks, and to government departments that require demonstration of a drought plan among eligibility criteria for access to drought relief programs. Federal policy requires producers to prepare and manage for drought (but without clear consequence if they do not). One state government, Queensland, is insisting on a drought management plan as prerequisite for applying for drought relief funding. NSW is showing signs of doing similar, but does not require a drought management plan yet. Producers could use our platform to show governments much better plans, with indicators and measures, than is currently required of them. Banks make loans decisions on financial viability bases. The platform could help producers provide evidence of their drought risk management, and hence improve their standing with their banks.

## 6. Future research and recommendations

### 6.1 Challenges

The challenges in the process of theme development included navigating a vast amount of information and tools on drought. This also represents a challenge for producers (or their advisers), who cannot conceivably invest the time to find, explore and test the usefulness of so many tools. Many existing tools primarily provide information on drought, but few address drought *resilience* or strategies for building resilience. There is a perception that many tools exist so surely there is no need for another. The reality is that most of the existing tools are focused on drought information, not resilience information or resilience-building; address parts but not all of the topic; and few are available nationally.

Another challenge was that the producers are keen to use our tool with their grazing management and stocking rate tools in particular. While a number of free resources exist, including MLA's spreadsheets, the most popular are proprietary tools, requiring subscriptions. This working group preferred those more advanced tools to the free spreadsheets. They would be very interested in having the platform link with some of the main proprietary tools should that become possible.

We see advantages and disadvantages in the overall project structure, which kept the five themes separate through the co-design phase, and managed by different entities. Tight focus has been an advantage, but has occurred at the expense of progressive cross-theme design. The Consortium members have cross-referenced as far as possible, but the reality is many of the producers have wisdom and experience to contribute on several themes each, and they manage their enterprises and lands for multiple outcomes relevant to this project. For instance there is a strong relationship between ground cover and drought resilience, since ground cover and the manipulation of stocking rates are very important in drought resilience.

The overall project's timelines, slowed in many cases by sub-contracting procedures and timelines, required each theme to deliver in a reduced time frame. Time required to hire support staff also ate into the timeframes, ultimately leading to a very tight time frame for holding the co-design meetings. Much pressure was placed on the team to conduct necessary background information gathering and prepare meeting materials at least a week before each meeting, but this was achieved and we are pleased with the quality of the materials. The evolving approach taken in the series of co-design meetings, particularly in the drought resilience theme, meant that the materials required for the next meeting were often not clear until the previous meeting concluded, so the team had to be very adaptive in gathering materials additional to those included in the scoping paper, on short notice.

Project timelines and budget also restricted the potential for close communication between the theme leaders (by this time representing the voices of the participants in the co-design groups), and those building the platform. While the platform builders had the design briefs to work from, there was limited opportunity for further conversations to interpret them as the platform builders might require, or to give feedback – informed by the co-design group's wishes – on the platform builders' translations of the brief based on their own inputs of expertise and practical exigencies. This risked deviation from the essence of the co-design group's wishes and advice, and hence a possible loss of faith with the producers. Producers will be able to comment on a prototype.

Further, mismatched contracting timelines across the platform build teams meant that learning materials had to proceed far in advance of the remote sensing. Thus it appears likely that the remote sensing will not play as great a role in the drought resilience part of the platform as the theme team and co-design group envisaged.

A further consideration, relevant to the entire platform, is the 'business model' necessary for maintenance of the platform. Ideally it should be free to use, but that would mitigate against updating. A user-pays model, enabling regular updating, is more relevant to the other themes, which are best positioned to gain commercial advantage from demonstrating their environmental performance. In drought resilience, the producers most likely to benefit are probably least likely to be willing to pay.

## 6.2 Successes

The co-design report (Cooper et al. 2022) and evaluation (Coutts 2023) have highlighted the outstanding success of the intensive co-design approach adopted for all themes in this project. These include the success of the small-group online meetings forced upon the entire project by COVID conditions but turned into an advantage, and the 'flipped learning' approach adopted to keep the focus of each meeting on discussion rather than presentations. From the perspective of the drought resilience theme, we highlight:

- This theme took a less structured approach to the meetings than the other themes did. This was partly to keep faith with our interpretation of a truly collaborative co-design approach (not structuring discussions so strongly as one of the other themes), and partly because of the complexity of the topic compared to some of the others, for which remote sensing and measurement options were more obvious. As we were all learning together (not 'consulting') we took an iterative approach, in which we began each meeting by recapping the understandings reached at the previous meetings, and allowing opportunity to comment further, before moving into the topics planned for that meeting. Meetings often ended by

introducing the topics to come. Written reports after each meeting were also used to present a cumulative picture of the shared state of understanding. These treated all decisions as provisional, and open for further revision. It was not possible to complete the series of meetings with final indicators and measures: doing so would have required more meetings. Instead, the co-design group members gave the team clear instructions to complete the refinement of indicators. We believe this was very successful as an approach and appealing to the producers since it allowed them to think through and express their needs thoroughly.

- The producers participating in the co-design groups gave very positive feedback on the entire process.
- The background materials produced in the scoping paper and for the co-design groups are an important resource in their own right, identifying, listing and evaluating online tools (existing, and in concurrent development with ours) and the best of learning resources relevant to the needs of producers and the platform.
- In terms of resilience studies, we believe this work to be a major step forward in showing how ecological, financial and personal aspects of resilience can be combined. To date resilience studies have been of two main types: on social-ecological systems (almost always at very large scales, e.g. river catchments), and in psychology and closely related disciplines (focused on individuals, particularly those at risk of mental illness, though work in the past decade has explored community resilience). There is also much work on 'organisational resilience' but it focuses mainly on large firms, not small family-focused businesses. Beef properties are an excellent 'case' of the complex interactions of environmental, business and personal aspects of resilience, and the actions the land owners and managers can take to influence all parts of their system. This is a major academic advance in itself. We have gone further, to explore the indicators and measures that can help to understand the resilience of a people-property system in beef production, and the learning resources that can help producers handle droughts better for the benefit of themselves, their businesses and the land.
- This is a pioneering study in the use of online technologies, for a purpose that has previously been concentrated in agricultural extension. It will enable self-organised learning, in their own time, which we hope will compensate for or complement face-to-face extension processes such as workshops and field days. While producers in one of the other themes affirmed the appeal of face-to-face processes, these are least accessible in the most remote parts of Australia, and always depend on potential attendees being aware of, and available on, the dates programs are offered.

### **6.3 Recommendations for future research and development**

Overall, the development of the theme and the online platform represents an important step towards building the sustainability and resilience of the Australian beef industry. Further research and implementation will be useful to maximize the impact of this initiative and contribute to further improvements.

#### ***Evaluation of the platform***

Additional evaluation of the platform should be undertaken some time after release of the platform, to assess its rate of adoption and perceived effectiveness in improving the drought resilience and sustainability performance of beef producers after there has been time to use it. This may include gathering feedback from users, measuring changes in knowledge and behaviour and assessing the impact on the sustainability of the beef industry.

### ***Research on market demand***

Further research should be undertaken to assess market demand for beef produced with environmental credentials, including for beef produced in a drought resilient way. This may include consumer surveys, market analysis and engagement with value chain partners.

### ***Research on verification and certification***

Research should be undertaken to explore the potential for verification and certification of drought resilience practices in the beef industry and exploring the potential for market-based incentives for producers who adopt drought resilient practices.

### ***Expansion to other agricultural industries***

The drought resilience theme has the potential to be adapted and applied to other agricultural sectors facing similar challenges. Future research should explore the feasibility of expanding the platform to other sectors, such as dairy, sheep, and grain production, in a way that differentiates from and adds value to the newly created DR-SAT.

### ***Demonstration to external parties, and development of an environmental credential for drought resilience***

Given the interest from banks and some state governments in having producers manage their enterprises in a drought resilient way, we recommend future development of the platform to enable producers the option of demonstrating their drought resilience management to external parties of their choice. This would make use of the information available on the platform in the producers' interests, and we believe improve on the drought resilience checklists currently required by state governments of producers seeking financial aid.

Over time, an environmental credential for drought resilience, or a component of a combined credential, could provide assurance to governments and banks that a producer is following best practices in managing their land and their business position to cater for droughts. This would be consistent with government expectations that producers take responsibility.

## **7. Acknowledgements**

The research team thank the eight producers who participated in the co-design process towards developing the Drought Resilience theme of the Environmental Credentials for Australian Beef project, and Tarni Cooper for her administrative assistance with the co-design process.

## **8. References**

BOM. 2022. *Australian Water Information Dictionary - Drought* [Online]. Bureau of Meteorology. Available: <http://www.bom.gov.au/water/awid/id->

[861.shtml#:~:text=A%20long%20period%20of%20abnormally,agriculture%20and%20other%20human%20activities">861.shtml#:~:text=A%20long%20period%20of%20abnormally,agriculture%20and%20other%20human%20activities](#) [Accessed 9 May 2022].

Cooper, T., van Bommel, S. and Ross, H. 2022. Milestone report: Environmental Credentials for Australian Beef: Smart Farms co-design. Report to Meat and Livestock Australia.

Coutts J&R. 2023. Review of the approach to co-design of the working groups for the Environmental Credentials for Australian Beef Project. Report to Co-design research team and Project Consortium, Environmental Credentials for Australian Beef Project.

MLA. 2022. *Maintain ground cover | Meat & Livestock Australia* [Online]. Meat & Livestock Australia. Available: <https://www.mla.com.au/research-and-development/Environment-sustainability/Sustainable-grazing-a-producer-resource/climate-variability-using-water-wisely/maintain-ground-cover/> [Accessed 9 May 2022].



## Appendices

### Appendix 1: Tools relevant to Drought Resilience theme

Content/method of delivery	Owned by	Scope	Status	Comments
<b>National</b>				
<b>National Drought Map</b>				
<a href="https://map.drought.gov.au/">https://map.drought.gov.au/</a>				In development
The map, currently being populated, will provide access to information provided by various third-party data custodians and websites. NDM facilitates the sharing of data from different sources and enhanced collaboration. It provides a framework of geospatial data services to support analysis, decision making, planning and reporting functions. Currently under development, with most of eastern states data inputted on the map.	Australian Government, National Drought and Flood Response & Recovery Agency, CSIRO	National	2019-2023	<u>Team comments:</u> Currently based on Local Government Areas (LGAs). Includes rainfall and soil moisture data. An example of relevant tools being linked on the National Drought Map is NSW's Combined Drought Indicator (CDI) – see below. <u>WG comments:</u> The
<b>Australian CliMate (app)</b>				
<a href="http://www.climateapp.net.au">www.climateapp.net.au</a>				Existing
The app brings together ten analysis tools, including 'How's the drought?', which provides a daily update of drought status for a location, including drought percentiles, rainfall deficit and residence period. It incorporates ideas from existing decision support tools. Also provides a monthly update of drought status using the Drought Percentile Method.	Australian Government, USQ and different R&D corporations	National	Up to date	The tool uses BOM's data and the Queensland Government's <i>Silo</i> database, which has grids of 0.05° x 0.05° degree resolution (approx. 5km x 5km).
<b>Climate Kelpie</b>				
<a href="http://www.climatekelpie.com.au/index.php/decision-support-tools">www.climatekelpie.com.au/index.php/decision-support-tools</a>				Existing
Climate Kelpie connects to tools and information about climate to help farmers in decision making. It compiles various decision-support tools developed by different organizations related to climate, grouped by major agricultural commodities across different Australian states.	MLA, GRDC, RIRDC, Sugar RDC, Meat and Livestock Australia, DAFF	National	Up to date	Farmers can filter content and decision-support tools (from a map or a list) for a specific region and commodity.
<b>BOM's Climate Guides</b>				
<a href="http://www.bom.gov.au/climate/climate-guides/">www.bom.gov.au/climate/climate-guides/</a>				Existing
Localised facts about the likelihood, severity and duration of key weather variables in regions across the country. The weather and climate information is delivered through a set of guides corresponding for each of Australia's 56 Natural Resource Management regions.	Bureau of Meteorology, CSIRO and FarmLink	National (56 regions)	Unsure	The guides were developed in collaboration with representatives from each NRM region. These may be tailored to the needs of beef producers.

Content/method of delivery	Owned by	Scope	Status	Comments
<b>MetEye</b>				
<a href="http://www.bom.gov.au/climate/climate-guides/">www.bom.gov.au/climate/climate-guides/</a>				Existing
An interactive tool for assessing weather forecasts, helps visualise local weather observations and forecasts, for any location in Australia.	Bureau of Meteorology	National	Up to date	MetEye™ contains information about Bureau forecasts and observations. This an online mapping tool based on GIS, used to visualise weather data for Australia.
<b>BOM's Drought Knowledge Centre</b>				
<a href="http://www.bom.gov.au/climate/drought/knowledge-centre/">www.bom.gov.au/climate/drought/knowledge-centre/</a>				Existing
BOM's Drought Statement examines soil moisture and provide contextual rainfall, drought, outlooks etc. The Statement also covers soil moisture levels can indicate the impact of rainfall received and discusses recent rainfall compared to historical records and the impacts on soil moisture and water resources. BOM's drought maps highlight areas with serious or severe rainfall deficiencies.	Bureau of Meteorology	National	Up to date	BOM's distributed water balance models are based on Australian Water Resources Assessment Landscape model (AWRA-L), which runs on a daily timestep and 0.05° grid (approx. 5 km).
<b>FarmHub</b>				
<a href="https://farmhub.org.au/">https://farmhub.org.au/</a>				Existing
FarmHub is a portal, providing access to many tools and sources of assistance, searchable by state. It includes the Drought Preparedness e-Guide ( <a href="https://farmhub.org.au/drought-preparedness-e-guide/">https://farmhub.org.au/drought-preparedness-e-guide/</a> ) along with farm risk management resources for drought preparedness. Climate Guides ( <a href="https://farmhub.org.au/climate-guides/">https://farmhub.org.au/climate-guides/</a> ) were developed in partnership with the Bureau of Meteorology and CSIRO, for each of Australia's 56 NRM Regions.	National Farmers' Federation (funded by Australian Government)	National	Unsure	The e-Guide has farm risk management resources for the farmers to identify the steps and tools to prepare them for drought.
<b>VegMachine</b>				
<a href="https://vegmachine.net/">https://vegmachine.net/</a>				Existing
VegMachine is an online tool that uses satellite imagery to summarise decades of change in Australia's grazing lands. It can generate comprehensive ground cover monitoring reports; measure land cover change or estimate soil erosion rates; view satellite image land cover products, and better understand the links between management, climate and cover in grazing land. The tool is simple to operate and free to use.	Fitzroy Basin Association, Queensland and Australian Government	National	Up to date	Allows the producers to draw polygons to select their property boundaries and also to import existing digital polygon mapping (e.g. paddocks on a grazing property). The tool provides seasonal compilation of ground cover data at 30 m spatial resolution.
<b>Weather Together</b>				
<a href="http://www.csiro.au/en/research/natural-environment/ecosystems/Weather-Together">www.csiro.au/en/research/natural-environment/ecosystems/Weather-Together</a>				In development
Integrates the private weather observations from the agriculture industry with the BOM observations and forecasts to provide tailored forecasts specifically for the location of the private weather station.	CSIRO and BOM	National	Up to date	Provides tailored weather forecasts. These can be localised for individual on-farm weather stations. Uses Senaps Analysis Service, which hosts a complex calibration algorithm to adjust the forecasts by localising them to the conditions for each private weather station.

Content/method of delivery	Owned by	Scope	Status	Comments
<b>CSIRO's Ag Climate Data Shop and GrazPlan</b>				
<a href="https://acds.csiro.au/">https://acds.csiro.au/</a> and <a href="https://grazplan.csiro.au/">https://grazplan.csiro.au/</a>				Existing
Ag Climate Data Shop hosts agricultural modelling produced by CSIRO, including historical, real-time and forecast weather and climate data and related analytics. GrazPlan is a set of decision support tools: GrassGro, GrazFeed and MetAccess. GrassGro is a computer program that delivers grazing systems research in a useable form to farmers and their advisers, while GrazFeed is decision support tool to predict animal intake and production. MetAccess ( <a href="https://grazplan.csiro.au/metaccess/">https://grazplan.csiro.au/metaccess/</a> ) is a computer tool for rapid analysis of historical weather data.	CSIRO	National	Up to date	GrazPlan is a set of commercially available decision support tools to make decisions about farm management, principally in grazing enterprises. MetAccess does not predict the weather but enables users to evaluate historical weather data to make more informed decisions.
<b>Rural Intelligence Platform</b>				
<a href="https://digitalagriculture.services.com">https://digitalagriculture.services.com</a>				Existing (with future development of 'Climate Resilience Hub™' proposed - no timeline)
This combines a variety of technology developed by CSIRO over the years, including the Digital Soil Map and satellite imagery analysis, to comprehensively assess and monitor rural areas. Climate information is interpreted to show the impact of drought, frost and heat stress for livestock on farmers.	Digital Agriculture Services (DAS) and CSIRO	National	Up to date	The platform combines artificial intelligence, machine learning and cloud-based geospatial technology to deliver farm data and analytics, including drought impact.
<b>Climate Services for Agriculture</b>				
<a href="https://climateservicesforag.indraweb.io/">https://climateservicesforag.indraweb.io/</a> (username: csa password: demo)				In development
CSA is a new digital platform (prototype available) enables access localised historical climate information and future projections for farmers in one location. It will include rainfall, temperature, heat risk, frost risk and evapotranspiration, and aims to integrate seasonal forecasts in future. CSA is planned to be linked with Drought Resilience Self-Assessment Tool (DR SAT).	CSIRO and BOM	National	Unsure	The tool has 'Northern beef' as one of the commodities in the prototype. Presents localised historical and projected climate information at a 5 km <sup>2</sup> scale.
<b>Content/method of delivery</b>				
<b>Owned by</b>				
<b>Scope</b>				
<b>Status</b>				
<b>Comments</b>				
<b>Northern beef region</b>				
<b>Northern Australia Climate Program (NACP)'s Drought Monitor</b>				
<a href="http://www.nacp.org.au/drought_monitor">www.nacp.org.au/drought_monitor</a>				Existing
The NACP's Drought Monitor has developed Australian Combined Drought Indicator (CDI). It uses a combination of rainfall, soil moisture, evapotranspiration, and Normalized Difference Vegetation Index (NDVI) from satellite to produce a Drought Monitor tailored for Australia.	Queensland Government, MLA and USQ (Funded through DCAP)	National	Up to date	NACP is replicating the concept of the U.S. Drought Monitor in Australia. It may be useful to link this tool with the National Drought Map.
<b>FutureBeef – Drought</b>				
<a href="http://futurebeef.com.au/drought">http://futurebeef.com.au/drought</a>				Existing
The FutureBeef website includes information on livestock drought feeding, and provides practical information to help producers manage during dry seasons. Range of excellent factsheets, reports and articles. Also includes 'Climate Clever beef'	QDAF, NT DITT, DPI-WA, MLA.	Northern beef regions	Up to date	Calculators for Breeding, cost of production, feed cost, agistment and links to climatic impact tools.
<b>Queensland</b>				
<b>The Long Paddock</b>				
<a href="http://www.longpaddock.qld.gov.au/">www.longpaddock.qld.gov.au/</a>				Existing
This tool supports decision making in grazing land management and provides current drought maps. The Long Paddock includes various useful online and spreadsheet tools to assess drought response or recovery options, and models to monitor key biophysical processes providing long-term time-series of rainfall and pasture growth. It hosts tools like <i>AussieGRASS</i> and <i>FORAGE</i> . <b>AussieGRASS</b> ( <a href="http://www.longpaddock.qld.gov.au/aussiegrass">www.longpaddock.qld.gov.au/aussiegrass</a> ) is a spatial framework that includes inputs of key climate variables (rainfall, evaporation, temperature, vapour pressure and solar radiation), soil and pasture types, tree and shrub cover, domestic livestock and other herbivore numbers. It integrates the impact of rainfall and its seasonal distribution with the impact of climate variables, and is used as a regional drought analysis system. The 'Rainfall and pasture growth maps' calculate important production variables such as pasture growth and pasture biomass. It provides evidence-based assessment of drought, which produces indices such as percentile pasture growth, total standing dry matter (TSDM), runoff and rainfall (at time scales of 1-36 months).	Queensland Government	QLD ( <i>AussieGRASS</i> has spatial database for Australia)	Up to date	<i>AussieGRASS</i> generates rainfall and pasture growth maps and time series graphs of climate and pasture variables on a sub-IBRA and Shire/LGA basis. The observed data are spatially interpolated to construct gridded datasets on a regular 0.05° × 0.05° grid (approximately 5 km × 5 km). <i>FORAGE</i> incorporates climate data, satellite imagery and modelled pasture growth for generating property-scale (for rural Lots on Plan greater than 1 hectare) to help decision-making in grazing land and environmental management, including Drought Assessment reports.

**FORAGE** ([www.longpaddock.qld.gov.au/forage/report-information/drought-assessment/](http://www.longpaddock.qld.gov.au/forage/report-information/drought-assessment/)) assists with drought assessment by generating Drought Assessment Information reports based on the AussieGRASS model; which includes rainfall, pasture growth, potential flow to stream, total standing dry matter (biomass) and a curing index for different time periods.

Content/method of delivery	Owned by	Scope	Status	Comments
<b>Rainman/ClimateARM – Agricultural Risk Management Tools</b>				
<a href="http://www.armonline.com.au">www.armonline.com.au</a>				Existing
ClimateARM uses historical weather records to analyse rainfall and temperature etc. at individual locations to improve climate risk management. It includes analysis records for individual locations for seasonal, monthly and daily patterns.	Queensland Government	QLD	Up to date	The tool provides the ability to analyse rainfall and other climate variables at individual locations, taking into account seasonal patterns and forecasts.
<b>Drought and Climate Adaptation Program (DCAP)</b>				
<a href="http://www.longpaddock.qld.gov.au/dcap">www.longpaddock.qld.gov.au/dcap</a>				Existing
DCAP offers forecast products, tools and extension material for financial risks and decision-making around droughts and climate variability. The tools help beef producers in Queensland to assess drought management options. <a href="https://futurebeef.com.au/economic-modelling-tools-to-assist-drought-response-and-recovery">https://futurebeef.com.au/economic-modelling-tools-to-assist-drought-response-and-recovery</a>	QDAF, Dept of Env. and Science (DES), USQ, BoM and MLA.	QLD	Up to date	The various modelling tools created under DCAP assist beef producers for drought preparedness and resilience by improving their profitability.
<b>New South Wales</b>				
<b>Drought Hub</b>				
<a href="http://www.droughthub.nsw.gov.au">www.droughthub.nsw.gov.au</a>				Existing
This website provides resources for primary producers preparing for/experiencing drought conditions. These include drought maps, state seasonal updates, Primefact information sheets and an interactive map on drought assistance available in NSW. Some tools include: <b>Drought Feed Calculator App:</b> Free mobile app to help farmers make informed decisions in dry times about determining the minimum feed requirement for different livestock, and compare the value of different feeds or a mixed ration. <b>Farm Tracker App:</b> The App helps farmers to record seasonal conditions on their property, such as conducting a crop, pasture or animal survey, keep a photo diary or monitor a paddock over many years. Reports and data can be saved in a personal database.	NSW DPI	NSW	Up to date	Farm Tracker mobile phone app allows farmers to track seasonal changes on their property over time. Each time a farmer fills in a report, they can create a geotagged photo diary, monitor dam levels, or record changes at an individual paddock level.
<b>NSW Combined Drought Indicator (CDI)</b>				
<a href="http://www.droughthub.nsw.gov.au">www.droughthub.nsw.gov.au</a>				Existing
This provides detailed seasonal conditions information for NSW primary producers, including drought. The CDI comprises four indicators: Rainfall Index (RI), Soil Water Index (SWI), Plan Growth Index (PGI) and Drought Direction Index (DDI).	NSW Department of Primary Industries (DPI)	NSW	Up to date	The data from NSW CDI has already been uploaded/linked with the National Drought Map.
<b>Western Australia</b>				
<b>Pastoral Remote Sensing (PRS) application</b>				
<a href="http://www.agric.wa.gov.au/rangelands/pastoral-remote-sensing-information-managers-western-australia">www.agric.wa.gov.au/rangelands/pastoral-remote-sensing-information-managers-western-australia</a>				Existing
PRS is based on satellite imagery. It provides mapping tools and estimates of cumulative rainfall, total green biomass, total dry matter and normalised difference vegetation index (NDVI) for every pastoral lease in Western Australia.	Western Australia Department of Primary Industries and Regional Development (DPIRD) and Landgate	Western Australia	Up to date	PRS has high resolution imagery for every pastoral lease in WA, with the station boundary and the land system boundaries in the station supplied. The image has 10 x 10 metre pixels, of either NDVI values, or the estimated total green biomass TGB.

## Appendix 2: Learning resources relevant to Drought Resilience

### Integrated resources (Best – recommended for inclusion)

Content/method of delivery	Owned by	Scope	Status	Comments
<b>National</b>				
<b>RCS's Drought Preparedness Course</b>				
<a href="https://www.rcsgloballearning.com/courses/rcs-drought-preparedness">https://www.rcsgloballearning.com/courses/rcs-drought-preparedness</a> The RCS course focuses on the principles of drought management and helps producers prepare a drought plan. It covers the 3 stages of Drought as: Drought Proofing, Drought Management and Drought Recovery. It is flexible and self-paced course, incorporating case studies that showcase successful localised practices to increase drought resilience. The course comprises videos and a workbook, also includes spreadsheets. The course participant's time investment is approximately 6 to 10 hours, plus the ongoing development of their drought management plan to keep on top of the lessons learned throughout its implementation.	RCS	National	Up to date	Recently developed/ launched  <b>Team comments:</b> Uses some indicators and measures suggested by the producers, e.g. calculating DSE, LSU, Carrying Capacity etc. The course is for beginners to users at more advanced levels. <b>WG comments:</b> Helped understand how the producers could tailor the tool to one's own business. RCS tool is great. However, RCS follows the grazing-for-profit approach, which is a bit like a 'religion' which has probably turned some producers away in the past. However, you can take what you want and leave the rest.
<b>Drought Resilience Self-Assessment Tool (DR SAT)</b>				
<a href="https://www.drseat.com.au/">https://www.drseat.com.au/</a> DR SAT is an online tool for drought resilience assessment for primary producers, and suggests ways in which farmers can build their resilience and adaptive capacity. Farmers can self-assess their resilience against a range of environmental, financial, personal and community resilience. The tool combines farmer-supplied information (allows drawing farm boundaries and commodities incl. beef) with national and regional information (remote sensing and climate projections). Based on farmer's personal, customised farm level resilience assessment, the tool produces brief suggestions called 'pathways' of options to improve drought resilience over time, with the suggested strategies and information based around goals the users select from a menu. Through these goal-focused pathways, it provides producers with options and links to different resources including articles, videos, tools, factsheets, programs and reports.	Deloitte	National	Up to date	Recently developed/ launched  <b>Team comments:</b> DR-SAT asks farmers to set goals and uses these to provide pathways to suggestions and information. The succinct pathways to improvement are a good feature, apparently to be filtered around a user's results and goals. The user selects a goal, and the tool would take them on the pathway to learning resources. It appears to be a useful attempt to combine environmental, business and personal aspects of resilience, with a nod to community resilience. The tool is suitable for users at different levels. <b>WG comments:</b> DR-SAT was quite good because you could make it specific to property level. The WG member found the platform to be surprisingly easy to use, a pleasant experience, very tactile (even on the iPad), and it was great having tiles.
<b>MLA Tools and Resources for building business resilience during dry times</b>				
<a href="http://www.mla.com.au/globalassets/mla-corporate/research-and-development/documents/210928-tools-and-resources-for-building-business-resilience_v6.pdf">www.mla.com.au/globalassets/mla-corporate/research-and-development/documents/210928-tools-and-resources-for-building-business-resilience_v6.pdf</a> A compilation of various tools and resources for building business resilience. It is an online PDF file, which lists, provides brief explanations of, and web links for selected events and resources (including videos and publications) and tools for: <ul style="list-style-type: none"> <li>• climate forecasting,</li> <li>• feedbase and natural resource management,</li> <li>• livestock management, and</li> <li>• business preparedness.</li> </ul> It is more than just 'business' resilience in the sense of financial; the topics are about a whole enterprise.	MLA	National	Up to date	Existing  <b>Team comments:</b> The approach is interesting, in that it is like a web portal pointing to many other resources via short introductions and links, but it can be printed off and used offline (though of course then you cannot use the links!). It caters for different learning styles via reading, listening, using spreadsheets. <b>WG comments:</b> Interesting compilation as there were good resources but did not include any personal preparedness element. It's not easy to navigate and the user has to email or sign up for newsletter or enrol in a course. In summary, the site has a huge amount of information relevant to producers interests but it is not user-friendly.

## Good – worth considering for inclusion or links

Content/method of delivery	Owned by	Scope	Status	Comments
<b>Climate Training - Forecasting for Decision Making</b>				
<a href="https://nacp.org.au/outreach/training/launchpad">https://nacp.org.au/outreach/training/launchpad</a> The Climate Course developed by the Northern Australia Climate Program helps producers understand and interpret long-term weather forecasts and use them effectively in decision-making. It guides the users on effective use of forecasting tools and provides links to relevant online drought related resources. Accompanied by Workbook - <a href="https://nacp.org.au/static/pdf/Workbook%20for%20Producer%20Videos.pdf">https://nacp.org.au/static/pdf/Workbook%20for%20Producer%20Videos.pdf</a> The course uses videos, accompanied by a workbook, to explain the different climate drivers that affect northern Australia.	NACP	Northern Australia	Up to date	Existing  <b>Team comments:</b> The NACP developed this learning resource to educate producers and landholders on important climate drivers for Northern Australia. The principles, though not necessarily the details, look applicable for other regions. It has practical exercises on interpreting rainfall forecast on MetEye, CliMate App, ClimateArm and is also good for finding and analysing historical data. <b>WG comments:</b> A member suggested weather forecasting be included somewhere, as the producers need to look at weather forecasting, including 4, 6 and 12 months ahead.
<b>More Beef from Pastures - Seasonal rainfall patterns</b>				
<a href="https://mbfp.mla.com.au/pasture-growth/2-seasonal-rainfall-patterns">https://mbfp.mla.com.au/pasture-growth/2-seasonal-rainfall-patterns</a> The free online manual helps characterise the seasonal pattern and variability of rainfall and establish water use efficiency. It shows users how to: <ul style="list-style-type: none"> <li>characterise rainfall and water use efficiency</li> <li>understand water balance</li> <li>apply water use efficiency information.</li> </ul> It involves active learning from activities, e.g. 'Build a record of the farm's annual total and normal monthly rainfall distribution'. In each section it explains what to understand, and why you need it: e.g. knowing the rainfall characteristics on the farm can help a producer to improve pasture growth and financial and environmental management through efficient use of rainfall in all seasons, particularly during periods of lowest pasture growth.	MLA	Southern Australia	Up to date	Existing  <b>Team comments:</b> The 'Seasonal rainfall patterns' is a section within the 'pasture growth' module of MLA's More Beef from Pastures, which is particularly relevant from the drought perspective. This resource is for 'business as usual' but does not make explicit how to apply these approaches in a proactive way towards drought. <b>WG comments:</b> Rolling rainfall indicators (rather than annual rainfall) are useful, and so is the ability for producers to use this in daily decision-making and drought preparation.
<b>Dry season management of a beef business</b>				
<a href="https://futurebeef.com.au/wp-content/uploads/Dry_season_mgt_of_a_beef_business_LowRes.pdf">https://futurebeef.com.au/wp-content/uploads/Dry_season_mgt_of_a_beef_business_LowRes.pdf</a> Focuses on whole enterprise, from perspectives of land and pasture, forage budgeting, income, sales and retention strategies. This manual is in pdf form, available online free of cost: <ul style="list-style-type: none"> <li>a guide to planning and managing cattle feeding in droughts.</li> <li>focuses on good grazing management decisions, backed up by clear reasoning on each issue</li> <li>gives detailed advice and reasoning on supplementary feeding</li> </ul>	Future Beef	Northern Australia	Up to date	Existing  <b>Team comments:</b> The manual provides information on feeding and managing livestock during drought, beef cattle nutrition including supplementation and crisis feeding, software packages to evaluate options and assist in decision making and strategies to help producers cope with stress. It focuses on planning before droughts, and drought recovery. <b>WG comments:</b> The drought resilience part of the platform should encourage and support planning and preparation for before, during and after droughts.
<b>MLA Drought Feeding</b>				
<a href="http://www.mla.com.au/research-and-development/livestock-production/livestock-nutrition/drought-feeding/">www.mla.com.au/research-and-development/livestock-production/livestock-nutrition/drought-feeding/</a>  This MLA web resource, available free of cost, provides information specific to stock feeding decisions. It: <ul style="list-style-type: none"> <li>Provides links to further details on relevant topics</li> <li>Covers the topics of Nutrition, Residues, Confinement feeding and Management considerations for feeding during drought.</li> <li>Guides on how to maintain livestock productivity and cashflow through drought, maintain core breeder numbers.</li> </ul>	MLA	National	Up to date	Existing  <b>Team comments:</b> Learning resource on land, pasture and livestock management, with focus on feed management during and at the end of a drought. It guides users as to how to maintain livestock productivity and cashflow through drought, and maintain core breeder numbers. The web resource is suitable for beginners to advanced users. <b>WG comments:</b> Members suggested that tool for drought resilience should help match feed demand with supply i.e., linking pasture growth (feed available) to feed budget while considering property type, management practices and location.
<b>FutureBeef – Drought management</b>				
<a href="https://futurebeef.com.au/knowledge-centre/drought/">https://futurebeef.com.au/knowledge-centre/drought/</a> This free resource has practical information to help beef producers manage their way through dry seasons. It contains links to information, videos, articles, tools with links to further resources under the Drought and Climate Adaptation Program (DCAP) and The Long Paddock website. Also links to drought information compiled by AgForce and Bureau of Meteorology climate and water outlooks.	Future Beef	Northern Australia	Up to date	Existing  <b>Team comments:</b> The website addresses the advanced learning needs of producers. It focuses on Northern Australia, but can be interpreted to suit all Australia, or could in principle be expanded to do so. <b>WG comments:</b> The Long Paddock and DCAP are useful for northern beef producers, it is easy to navigate. Information from other sources is important but must be regularly updated (e.g. Southern Oscillator Index wasn't).

## Calculators and software

Source	Comments
<ul style="list-style-type: none"> <li>• <a href="https://etools.mla.com.au/src/#/beef">MLA stocking rate calculator</a></li> <li>• <a href="https://stocktakeglm.com.au/index.html">Stocktake GLM App</a></li> <li>• <a href="https://aucalc.rcsaustralia.com.au/cattle">RCS Rating Calculator</a></li> <li>• <a href="http://www.maia grazing.com">MaiaGrazing*</a></li> <li>• <a href="http://www.mobble.io">Mobble *</a></li> <li>• <a href="http://www.agriwebb.com">Agriwebb *</a></li> </ul> <p>*user pays</p>	<p><b>Team comments:</b> Different stocking rate calculators are available free from MLA, RCS and Stocktake, while Maia Grazing, Mobble and Agriweb are user-pays. The user-pays software offers additional features such as paddock management, mob management, grazing management, rainfall records, farm mapping.</p> <p><b>WG comments:</b> Members referred often, across several meetings, to their wish to be able to link their preferred stocking rate software to our tool. Maia Grazing was mentioned most often; none mentioned use of these free tools.</p>

## Case studies

Source	Comments
<ul style="list-style-type: none"> <li>• <a href="https://www.mla.com.au/research-and-development/Environment-sustainability/climate-variability/climate/#:~:text=MLA%20is%20an%20investment%20partner,changes%20in%20weather%20and%20climate">Producer case studies - MLA's Weather and climate variability</a></li> <li>• <a href="https://www.longpaddock.qld.gov.au/dcap/grazing-industry/case-studies/">Case Studies and Narratives - Drought and Climate Adaptation Program</a></li> <li>• <a href="https://agriculture.vic.gov.au/support-and-resources/case-studies/drought-case-studies">Drought case studies – Agriculture Victoria</a></li> <li>• <a href="https://www.rcsgloballearning.com/courses/take/rcs-drought-preparedness/texts/29137569-producer-case-study">Case Studies - RCS Drought Preparedness</a></li> <li>• <a href="https://futurebeef.com.au/projects/grazingfutures/">GrazingFutures case studies</a></li> </ul>	<p><b>Team comments:</b> Case studies offer a personalised accounts of strategies particular producers are using, and so can be a very effective learning resource especially to complement information provided in other ways. These case studies focus specifically on drought, but there are others (e.g. ABSF under 'economic resilience'), which are not specific to drought but have some relevant strategies if you listen for them carefully.</p> <p><b>WG comments:</b> members referred often to liking to hear from other producers, learn from their experience, and to hoping to have producer case studies including among the learning resources in our tool. They were not specific as to the style of those case studies, e.g. written with photos, short video, key points.</p> <p><b>WG comments:</b> Members mentioned that case studies would be good learning resource and peer learning is generally liked by producers.</p>

## Appendix 3: Scoping paper

# Demonstrating beef environmental credentials

## Background scoping paper for the Drought Resilience theme

Prepared September 2021

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### Introduction

#### Purpose of this paper

This paper provides you with background information for the series of Drought Resilience Co-design working group meetings. In it we:

- explain how we understand ‘drought’, and ‘resilience’, and provide other important information
- set out a ‘scope’ for our designing discussions around drought resilience
- document tools with relevant features that we know are already available or in development in this field.
- pose topics and questions to assist our discussions.

We will also provide briefing at the first and subsequent meetings, and offer opportunity to ask questions.

Information on the entire environmental credentials for Australian beef project (referred to here as ‘overall project’), which the Drought Resilience theme sits within, and on what to expect as a participant in the co-design process, will be provided to you separately.

The following text is provided to guide an informed discussion about what is needed, and what a useful tool developed under the Drought Resilience theme would be like.

It is important that our tool fills any gaps and does not duplicate other work. If we decide it cannot improve on what other tools offer beef producers, we have the option not to proceed with a drought resilience tool within our overall online platform.

#### Purpose of this theme

The Drought Resilience theme is one of five themes being developed within the environmental credentials for Australian beef project, which will develop an online tool for beef producers that offers options to assess, demonstrate, and learn more about how to improve, environmental sustainability on their property. The other themes are Tree Cover, Ground Cover, Biodiversity Stewardship, and Carbon Balance.

The other themes in our project have clearer links to emerging needs from markets, e.g. for demonstration or verification of on farm environmental performance (i.e. environmental credentials). There is no direct equivalent to a market-participation credential for drought resilience, although we understand that some banks or insurers may seek assurance that producers are doing their best to reduce risk, and they may modify premiums to favour those who are preparing well for droughts.

We expect that some of the themes may share features. We will build a process for communication across all the themes into the overall process, so that all the work combines to produce one linked set of tools on a single platform.



As the name suggests, the Drought Resilience theme is intended to provide a resource to support producers to anticipate droughts, and manage their land well to cope with and recover from droughts (i.e., be resilient). It should be more than a drought information tool: the focus is *drought resilience*, and credentials.

Taking a comprehensive view of all dimensions of drought resilience could entail physical information (climate and weather, environment and land use management), business management, and personal and community dimensions of resilience. All of these interact in the realities of managing a property. In the Drought Resilience theme we intend to focus on the physical dimensions, for two reasons. The first is that the overall platform focuses on land and related credentials and information. The second is that another tool in development by another organisation (the Drought Resilience Self Assessment Tool or DR-SAT, see below) is going to cover environmental, business and personal dimensions, and we are cooperating closely with the developers of that tool. We can discuss this further in our meetings.

We are also aware that a number of other programs have, or are now developing, tools with similar purposes to ours, or that share some capabilities. Some of this is related specifically to beef, other tools are not, but are capable of encompassing beef needs. Thus this theme involves making choices about what our tool can offer, adding value to and not duplicating what will become available.

### **Potential benefits in developing a Drought Resilience tool for grassfed beef producers**

Note that in line with the overall project's focus on developing a means of demonstrating *environmental credentials*, we are focused on resources to help producers demonstrate their achieving drought resilience.

To be truly resilient requires attention to climatic factors, land and property management, business management, and personal and family dimensions. There are strategies available for all of these, but they are currently presented separately rather than linked into a holistic perspective on resilience, not available in all states and territories, and few are linked to beef.

We can provide, and make it easier to find, link and interpret, useful resources. There is also great opportunity for beef examples, e.g. written accounts with photos, or even film clips, of producers showing and explaining their land management strategies.

### **Initial design criteria**

The output for the co-design process is a design brief (instructions) for a technical designer who will build the online platform we ask for, and load up any models or information content we supply.

We suggest the following design criteria. We invite the working group to confirm or amend these.

- The proposed drought resilience tool must meet and be tailored to the needs of beef producers (designed by producers, for producers).
- It should help beef producers in the continuous cycle of planning and operations in preparation for drought, during drought, and recovery.
- It should be practical to use.
- It should suit the bandwidths and technical skills available to most producers, including in remote areas
- Ideally it should suit the differing contexts of different beef regions
- Data must be available to incorporate, at appropriate spatial resolutions to be useful, and affordable.
- It should enable producers to compare or combine their results with those of other state programs.
- The data needs to be sufficiently fine scale to detect changes at the property level which are meaningful for the producers

- Information and advice should be presented in appealing, accessible ways

## Understanding ‘drought resilience’

The theme requires definition and linking of two key concepts, drought, and resilience.

### Drought

Drought is often seen as a one-off event, an aberration of nature (an ‘exceptional circumstance’) or a natural disaster. However, we should view it as a recurring type of event, expected in Australia’s climate. Further, drought conditions are likely to become more frequent, severe and longer due to climate change (Australian Government 2019). Further, it is possible to induce drought like effects through inappropriate land management practices (Drought Policy Review Task Force, AGPS, 1990).

There is no agreed standard definition of drought. The Bureau of Meteorology (2021a) defines it broadly as

*A long period of abnormally low rainfall, especially one that adversely affects agriculture and other human activities.*

The seminal Drought Policy Review Task Force (1990) explained the risks of drought as including severe damage to the land, permanent run-down in the capital and resource base of the farm, and the extreme financial risks faced by individual producers in the industry.

The National Drought Policy of 1992 (Commonwealth of Australia 1992) presents drought and managing for drought as an integrated issue involving climatic variability; management of the farm, including resource management (land care, soil conservation, vegetation), production management (including farm planning, and self-education), and financial management (e.g. financial planning, income smoothing and off-farm assets); government policy and supports; and research and development.

### Types of drought

- Meteorological drought – rainfall deficiency
- Hydrological drought – reduced river levels, water in storages, soil moisture
- Agricultural drought – reduced productivity, lost income, strain on the agricultural community
- Socio-economic drought – when effects spread through the wider community.

For our purposes it is helpful to distinguish between the meteorological, hydrological (rainfall, and water in the landscape), and agricultural elements. Importantly, the management of land and vegetation before and during drought will affect its ability to recover. These biophysical aspects link to education, business management, and mental health. All of these can be considered at multiple interacting levels, from individual to property, community and national (policy) levels. Our focus, however, is the property.

#### Take-home messages:

- Drought is a recurring feature in Australian climate and landscapes
- There are four types of drought – about rainfall, water in storages, reduced agricultural productivity and financial duress, and wider socio-economic effects
- Land management is important in the experience of drought, and ability of land to recover.

## Resilience

Resilience conveys the ability to withstand shocks, both in terms of good preparation (building strong ability to reduce the effects of the shock), and putting oneself in the best possible position to navigate the shock, and come out of it well – having learnt and prepared more for future shocks. Resilience is thus a cyclical process, involving preparation, experience, recovery, learning, and more preparation.

Resilience (or lack of resilience) can involve supportive (or unsupportive), relationships at multiple levels from individual, property, region, industry, national, and even international, usually interacting and influencing one another. For example government policies and programs (state or national level) seek to influence and support what producers (property level) do.

Some helpful research (Helfgott 2018, p. 854) suggests it is important to consider the resilience:

- ‘of what’ (in our case, broadly the grass-fed beef industry, but at what scale do we want to focus – property only, or also region?)
- ‘to what’ (droughts, recognising they can be of particular magnitudes and durations)
- ‘for whom’ (for what types of user, e.g. producers, in their different regions?)
- and ‘over what timeframe’ (should we measure over months or years, for instance? Should we consider the resilience over decades?).

Resilience is related to sustainability, but is not exactly the same. Properties and their management need to be both: sustainable, and able to cope with shocks as weather conditions, land capability and market conditions change owing to droughts. Resilience is also related to vulnerability, but they are not opposites. It is possible to be both vulnerable (subject to weather shocks), and resilient (well positioned to cope with them).

A useful insight from psychology (about people’s resilience) is to focus on building from strengths (a strengths-based approach), not on overcoming weaknesses (known as the ‘deficit model’). In land management terms, this idea might translate to working with the natural assets (strengths) of each region and property: what opportunities do these offer?

‘Bouncing back’ is not a helpful idea or terminology in resilience. Resilience is not about a return to normal. It is more often about constructive change within an ever-changing, dynamic system.

Research (Carmen et al. 2021, under review) points out one can distinguish between:

- reactive resilience aiming to return to ‘normal’,
- responsive resilience (learning from the shocks and how to respond),
- proactive resilience (involving more foresight, preparation, learning, and often systemic interventions, e.g. government-industry cooperation).

Response after a disturbance is not usually rapid, or a linear process. A system, or a person, can increase in resilience over a succession of shocks, perhaps through learning, and building strengths. However, ecological systems or people can become more ‘brittle’, so that they are more easily disturbed by successive – and smaller - shocks.

### Take-home messages:

- Resilience is about coping with shocks (drought)
- It involves cycles of preparation, experiencing, recovering, learning, and preparing more
- Both sustainability and resilience are important
- It is not about ‘bouncing back’ (returning to the old system). More often, it is about moving forward in new and better ways.

## Policy context

The Australian government has expected farmers to prepare for and share responsibility for droughts for at least 30 years. Under the Intergovernmental Agreement on National Drought Program Reform, signed in 2013 by Australian, state and territory governments, all governments aimed to encourage farmers to better prepare for droughts and manage their business risks. The National Drought Agreement, signed in 2018, includes objectives to:

- Enable farming businesses, families and communities to manage and prepare for drought, climate change and variability, by supporting their long-term sustainability and resilience, the adoption of robust risk management practices and sound natural resource management
- Increase the adoption by farming businesses and the farming sector of self-reliant, sustainable and resilient approaches to manage business risks, through improved skills, planning and monitoring tools, business decision-making, and the adoption of new knowledge and tools from research and development.

Current Commonwealth and state policy thus emphasises drought resilience, focused on drought preparedness, management and recovery at multiple levels including individual or family, business, community and sector.

The Commonwealth and state governments are now investing in a range of information and other supports<sup>4</sup>, which we will describe further below.

### Take-home message:

- Rural businesses have an increasing responsibility to plan individualised strategies to cope with future droughts.

## Towards developing a tool

We would like the working group to consider the following issues in order to help decide whether a drought resilience component would be valuable in the overall platform, and if so, what it should offer, and what form it should take. The first contextualises the subsequent questions, by asking the co-design working group to think about current producer decision-making towards handling droughts.

### What types of decisions do producers currently make, towards resilience?

Good years are important to foster resilience of the land and the business when droughts come. What plans and decisions do producers currently make, preparing for, during and after droughts, to increase their land's resilience? What types of information would help them with this?

As a drought begins, and during it, what types of decisions do they make? What decisions do they make in emerging from the drought, and learning from it later?

What types of information might be useful to them at these decision times? In particular, what would help them to demonstrate what they are doing, if they need to do so?

<sup>4</sup> To our knowledge, all planned and funded since our National Landcare grant. Many of these are in contracting and early development, so ultimate content is not clear.

**Discussion questions:**

- What types of decisions do producers make:
  - In good periods, to prepare for droughts
  - Entering and during a drought
  - Afterwards?
- What would help them to demonstrate what they are doing?

**What might a Drought Resilience tool offer? What would be most useful to beef producers?**

We envisage a user-friendly platform that enables producers to query information about their property, and possibly their region, to assess their drought risks, and key indicators of how well their land use management is positioned to provide resilience to those risks. This could encompass preparation for drought, and optimising conditions for recovery.

The drought resilience tool could provide useful information about what producers can do to improve, or link users to where that information is available. (We can also consider whether the drought resilience tool could host content developed by others (e.g. drought resilience content to be developed by a set of Adoption and Innovation hubs funded under the Future Drought Fund<sup>5</sup>).

**Discussion questions:**

- Broadly, what could our tool offer towards producer decision-making?

**What might a Drought Resilience tool consist of?**

The other project themes anticipate developing tools using a combination of:

- remotely sensed data to monitor, or indicate, environmental qualities e.g. tree cover, ground cover, percentage of moisture, pasture biomass, percentage of bare soil vs ground cover. Thus we envisage all themes sharing a 'core' of remote sensing data, though details and uses may differ.
- data that cannot be remotely sensed, and needs to be included in some other way (e.g. carbon emission estimates, for the carbon theme). This type of information would need to be entered by the users.

Calculators (or models<sup>6</sup>) that link and present the data in useful ways.

**What types of information or topics should it cover?**

There are opportunities to consider many topics and types of information, though tools exist (or are in development) for some of these already.

- Meteorological (rainfall) drought
  - online risk calculators and monitoring tools
    - existing and future examples of these are:
      - The National Drought Map, currently in development (<https://map.drought.gov.au/>)
      - Longpaddock climate risk information for rural Queensland, <https://www.longpaddock.qld.gov.au/>);
- Hydrological drought (water availability)
  - topics would cover for example river levels, water in storages, soil moisture

<sup>5</sup> Summary information is at Australian Government Department of Agriculture Water and Environment, Future Drought Fund, <https://www.agriculture.gov.au/ag-farm-food/drought/future-drought-fund>

<sup>6</sup> In the sciences, a 'model' can refer to a simplification of reality constructed to gain insights into the key attributes of a physical, biological, economic, or social system (what are the important variables and how do they interact), and/or to computational processes representing the behaviour of such systems.

- soil moisture information is readily available via remote sensing
  - online risk calculators and monitoring tools
  - information and strategies
    - specific advice is likely to be part of agricultural strategies, so is covered below.
- Agricultural drought (land use management): risk calculators, monitoring tools, information and strategies
  - tree cover and ground cover
    - this is available from remote sensing data, and will almost certainly be built into our overall set of tools through the work of the other themes. It is also incorporated into some other existing tools and tools under development, see appendix 1.
  - water supply
    - soil moisture is available from remote sensing
    - watering points are usually well known to producers (rivers, dams, and those they have built). We are unsure at this point what information, particularly on water levels, can be derived independently.
  - land management
    - several online tools, e.g. FORAGE (reviewed below) offer property-scale decision support information for grazing land and environmental management. Longpaddock (Queensland, reviewed below) offers drought assessment reports, information on rainfall and pasture by land type, and ground cover (with regional comparison for ground cover). Users may subscribe to have reports emailed to them, for specified time periods e.g. monthly.
    - a large amount of information about what to do exists and is in continual improvement, but availability appears to be uneven by state and purpose. One challenge apparent from our review is navigating it, supporting producers to find their way to what they need. Clearly, advice needs to differ by beef region.
    - hubs, e.g. FarmHub (see below), offer gateways to this type of information
    - information on herd decisions includes carrying capacity, stocking rates, and breed options (e.g. Droughtmaster genetics)

A national tool in development, the Drought Resilience Self-Assessment Tool (DR-SAT, see appendix 1) is to include business and personal resilience, and touches on holistic resilience through its user summaries.

#### Discussion questions:

- What topics should the tool cover, for producing useful property-level information?

For all of these potential topics, we need to consider sources of information available, at what level of detail, and with what frequency. Sometimes the broad information is available free of charge, but charges are imposed for finer-scale information.

### Is a Decision Support System desirable within the tool?

Many of the more useful tools, including some reviewed in this paper, involve computations ‘behind the scenes’. Decision Support Systems (DSS) provide flexible mechanisms for analysing data to help a user to understand problems, track changes on their properties, and explore opportunities and possible solutions, and so inform decisions. They enable the decision maker to select what they want in both content (what information) and how they would like it to appear (output format).

Options for decision support systems to or within the drought resilience theme could include:

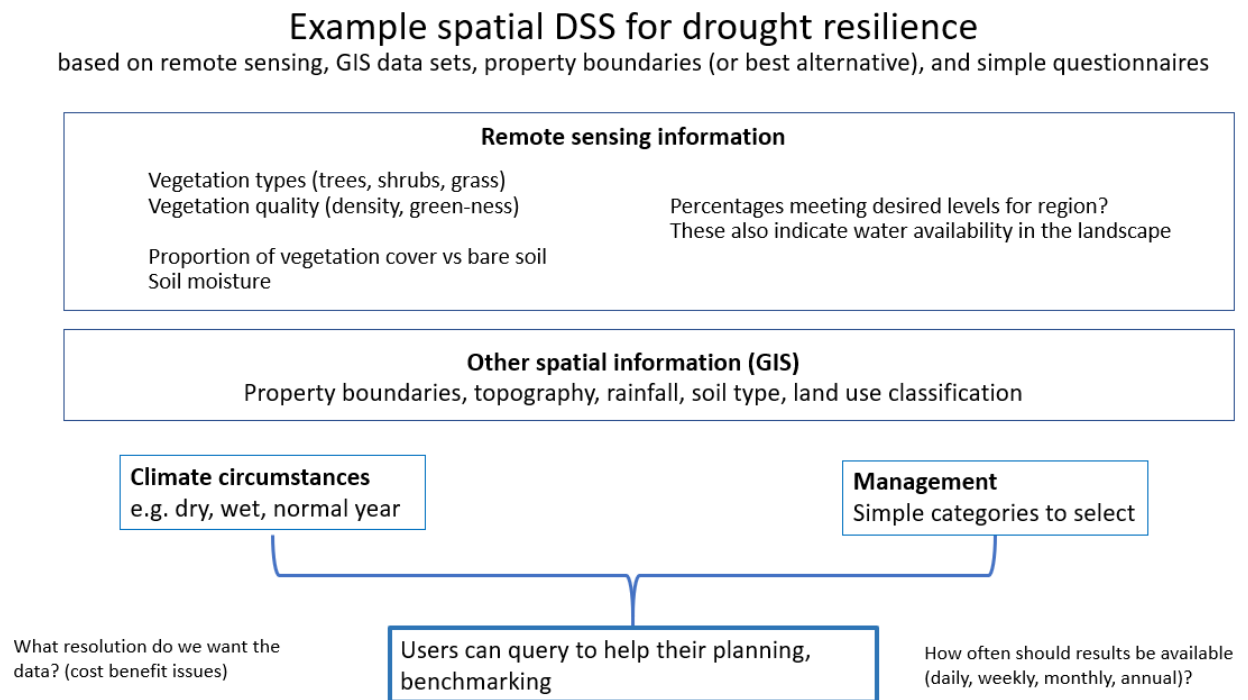
- a spatially-based (map based) DSS using remote sensing data (much of it shared with the overall project) which can be used to monitor ground cover, biomass, soil moisture etc. It could link such information to other spatial data sets such as topography, rainfall, soil type, land use classification, along with property boundaries. These data sets could be integrated through a ‘model’ running behind the scenes.

A DSS could enable users to query the data in different ways, to explore each aspect of drought resilience, as far as their property is concerned.

Given the availability of potential tools, a drought resilience theme tool may need to link information currently offered through other tools. It could extend types of information to be offered nationally, as well as that available in some states or territories, but not others.

The potential is illustrated in the Fig. 2.

**Figure 2 Schematic of the information that could be used to produce a decision support system to help users assess drought risks, plan and organise for drought.**



## Indicators and measures

### Background

An ‘indicator’ indicates something, while a measure gives as precise as possible a measure of it. Indicators are often used as suggestions, e.g. the presence of particular plants may indicate that soil is frequently waterlogged, or the presence of certain species in a soil sample can indicate soil health. Many indicators can be calculated from combinations of data.

Models, explained in footnote 3, often use indicators for the key variables in their computations.

### Indicators and measures available

In all fields relevant to our online platform (drought resilience and other themes), there are indicators that have already been used to suggest underlying conditions and trends. Where possible it makes sense to use indicators and measures already in common use. This is efficient, consistent across industries and sectors, and assists with meaningful comparisons. Indicators for each theme in the overall project need to be agreed by the co-design working groups, taking existing indicators into account.

The existing and potential indicators relevant to the drought resilience theme are discussed here, focusing on meteorological drought and agricultural drought indicators. Where an indicator relies solely on precipitation in its calculation, the indicator is considered a meteorological indicator. Agricultural drought indicators define the drought event as the deviation of the soil water balance from normal levels. Agricultural drought is of interest to this theme due to its close relation with cattle feed availability linked with level of moisture in soil.

In terms of combined drought indicators, the drought resilience and exposure indicators being developed under the National Drought Map are likely to be the most relevant. The prototype currently available includes the NSW Combined Drought Indicator, which is based on indexes of rainfall, soil water, plant growth and a 'drought direction' index. The National Drought Map is currently being further strengthened by incorporating the ABARES Drought Indicators providing a wide range of climatic and economic data that will provide information on drought conditions and how these impact different regions. Further, as exposure of agricultural lands to different levels of drought can be estimated using land use/land cover data and drought occurrence data, some indicators and measures from other themes, e.g. ground cover, are relevant for drought.

In Australia most **meteorological drought** indicators are calculated mainly from The Bureau of Meteorology's Australian Water Availability Project (AWAP; <https://eodata.csiro.au/projects/awap/>) daily precipitation analysis, which provides high resolution rainfall data. The AWAP precipitation data is available with daily time resolution and 5 km spatial resolution. The AWAP also provides some indicators and measures of **hydrological drought**, e.g. water balance maps based on upper and lower layer soil moisture relative to averages for the time of year.

Some **agricultural drought** (or related) indicators and measures are included in the Australian Beef Sustainability Framework under Environmental Stewardship.

(<https://www.sustainableaustralianbeef.com.au/the-framework/environmental-stewardship/>). A

Balance of tree and grass cover dashboard

(<https://www.sustainableaustralianbeef.com.au/resources/botgc-dashboard/>) illustrates the use of measures to provide indicators. There are categories of measure based on areas of forest, woodland, and ground cover. The measures related to these types of cover include change in area for that type of cover, over a selection of time periods. Preferred levels can be selected, e.g. 70%, or 80% ground cover, achieved over a nominated percentage of the area studied. These allow easy representation of whether land management targets are being met. (Searches can be made according to a wide range of areas, from NRM regions to local government areas and postcodes. Properties cannot be selected, but can be identified approximately from the maps).

An important concept specific to resilience is the idea of thresholds, levels which represent a dangerous point beyond which land may never recover from drought damage. While the precise levels are not well known, and would differ by region, the concept is important. Thus we suggest focusing on the most important indicators related to land damage and recovery.



Appendix 2 lists a selection of key indicators available.

### Technical challenges

A current challenge for developing a property-focused tool is that it is not easy to overlay property boundaries on the tools based on remote sensing. We are told property boundaries are notionally available among Geographic Information System information layers, but too inaccurate. We are finding out more about what is possible. Among existing tools and those in development, at least one state tool does offer property boundaries, but much work may have been necessary to draw or verify these. Most existing tools and those in development are offering online maps, but expect the users to draw in their own property boundaries over general information provided for their areas (or nationally). Some tools enable the user to pick out their property by giving lot numbers. A property mapping tool is in development, but not expected to be available for wide use. We assume beef producers would prefer to have their property boundaries pre-supplied; this feedback has been given to the producers of another tool. (That developer also heard producers would like to be able to select several properties together if they own or manage several; developer, confidential personal communication July 2021).

Internet capacity and reliability is a serious consideration for users, and hence for design.

### What tools exist already, or are under development?

There are multiple but scattered sources of information, tools, learning programs and resources available on drought, fewer on drought resilience. Some have similar or overlapping functions, to each other and to our proposed tool. Much of what exists or is in development either deals with 'drought' with respect to climate and weather predictions, or maps the landscape using various indicators. While these tools can be informative about drought, they do not necessarily help with the essential aspect of resilience – withstanding shocks. We are not aware of any tools that demonstrate resilience *credentials*, though it is possible some could be turned to that purpose.

This section reviews existing tools, and tools under development, according to what they offer. Some tools are available nationally, or will be. Others are available only for one state, or for specific regions. Most tools are generic to all types of farming, not specific to beef producers though they appear to serve their needs. A summary of existing and tools, and tools under development, that have linkages to drought resilience is provided below. A more comprehensive list, including tools reviewed below, is provided in Appendix 1.

#### National tools

Both national tools we have identified are hybrid, focused both on supporting assessment and providing information.

#### The National Drought Map

The National Drought Map is an online tool being developed to bring information on drought conditions and programs together. It is developing from its base as an information tool, to becoming a central platform to consolidate many of the different online information tools, including the existing tools on platforms like FarmHub (see below) and from other agencies at the national and state governments, alongside tools under development such as the Drought Resilience Self-Assessment Tool and interactive digital 'climate information services' provided through the Climate Services for Agriculture program.

Further, the National Drought Map's online tool also aims to develop additional drought indicators on drought resilience and exposure indicators for improved forecasts and local information to understand changing conditions and emerging impacts. The Map will provide access to spatial information on drought conditions and support measures to assist with analysis, decision making, planning and reporting. It is intended that the Map will be further strengthened from the inclusion of the ABARES Drought Indicators, providing a wide range of climatic and economic data that will provide information on drought conditions and how these impact different regions.

Linked to the National Drought Map, multiple projects are currently being developed to help farmers better manage the impacts of drought risk for drought resilience under the Future Drought Fund (FDF). The Climate Services for Agriculture program aims to develop and deliver interactive digital 'climate information services' for the agriculture sector to assist farmers to make real-time decisions. The Drought Resilience Self-Assessment Tool is a self-assessment tool for farmers to self-identify drought risks based on a range of social, economic and environmental indicators. It provides briefly stated 'pathways' to take action to build the drought resilience of their farm business.

### **FarmHub**

FarmHub (hosted by the National Farmers Federation) is essentially a comprehensive portal to developed to provide an online, centralised point of access to trusted information on support and programs from all levels of government, industry groups and not-for-profit organisations. It includes access to 11 tools for drought preparedness (including Queensland's The Long Paddock, reviewed below), and access to information, e.g. links to factsheets for each NRM region. Users can select these tools by state, but the number and quality of resources available in each state varies. .

### **State and regional tools**

#### **Tools focused on measuring and assessing environmental condition (especially using remote sensing)**

A range of tools offer interactive, searchable information, based on remote sensing and sometimes other information sources. None so far give a complete picture of vulnerability to drought or preparedness for it. (As we mentioned above, many of these are linked through the FarmHub portal, and possibly other portals).

Some of the existing drought tools developed by relevant state government agencies are more advanced than others. There are relevant tools for Queensland, NSW and WA, but we have not discovered any for Victoria, South Australia or Tasmania (though generic tools for all agriculture will cover these states). There is potential to link with (with permission) and expand the best tools, for example the Pastoral Remote Sensing (PRS) application from Western Australia could in principle be replicated in other states to offer similar mapping tools, based on remote sensing, to provide estimates of cumulative rainfall and normalised difference vegetation index (NDVI) etc.

#### **Tools focused on providing management information for droughts**

What should a producer do in order to improve their management practices so as to become more resilient to droughts? There are many tools, and online statements, offering such information. We are not attempting to catalogue these at this stage, but could do so at a later stage in the Co-design process if the information is deemed useful.

At this stage it is more useful to consider the formats available for offering management information specifically on, or relevant to, droughts. Existing tools and those in development offer various useful options to consider for presenting information. These range from:

- Very short indicative statements or principles, e.g. the DR-SAT ‘pathways’, so far drafted as one to three-line suggestions presented alongside the assessment summaries that a user will receive on querying the tool. In the current prototype, these are customised to the user’s results on queries, and goals they have listed.
- One to two-page factsheets (e.g. the climate summaries for NRM regions downloadable from the FarmHub<sup>7</sup>; the Climate Clever Beef factsheet [give location])
- More comprehensive information, provided in web page format or pdf-printable formats, including full reports (e.g. Bowen et al. 2019).
- Personalised case studies and stories, featuring what particular producers have done on their properties.
  - e.g. written accounts with photos, or short film clips, of producers showing their contexts and strategies.
- We also assume the existence of discussion boards and the like, for informal exchanges of information, though they may exist e.g. on social media.

A large amount of information and advice will start to flow from Drought Resilience Adoption and Innovation Hubs, and associated research projects. One option to consider with those hubs is whether beef related information could or should be linked to or through our tool. It may be provided through the National Drought Map collection, though that may not single out beef.

#### Discussion questions:

- How does knowledge of what is currently available, and in development, affect our initial vision?
- What can we do, if anything, that improves on or integrates these – for beef producers?

## Ultimate question: Is a Drought Resilience tool or theme needed in the beef environmental credentials platform?

Given the points considered so far, we ultimately need to consider whether a Drought Resilience tool is useful to have within the overall online platform. Or, are other existing tools and tools in development going to be enough for beef producers – in all regions? If drought resilience should be included in the overall online platform, what should this part of the platform offer?

Alternately, we may, after exploration, decide that we are not able to add enough value for beef producers, to what other tools will soon offer, and we need not develop a drought resilience tool ourselves.

#### Discussion questions:

- All points now considered, what is the value of our developing a tool that supports producer resilience in the context of drought?

## References

Australian Government 2019, Drought in Australia: Coordinator-General for Drought’s advice on a Strategy for Drought Preparedness and Resilience, Canberra.

Bowen, M.K., Chudleigh, F., Rolfe, J.W and English, B. H. 2019. Northern Gulf beef production systems: Preparing for, responding to, and recovering from drought. Queensland Government

<sup>7</sup> <https://farmhub.org.au/climate-guides/>

Department of Agriculture and Fisheries. [https://futurebeef.com.au/wp-content/uploads/2019/11/DCAP-DAF6\\_Northern-Gulf\\_Management-strategies-for-drought-resilience\\_June-2019.pdf](https://futurebeef.com.au/wp-content/uploads/2019/11/DCAP-DAF6_Northern-Gulf_Management-strategies-for-drought-resilience_June-2019.pdf)

Bureau of Meteorology 2021a, Australian Water Information Dictionary, viewed 6 August 2021, <http://www.bom.gov.au/water/awid/id-861.shtml>

Bureau of Meteorology Drought Knowledge Centre, 2021b, What is drought: video clip. Viewed 6 August 2021. <http://www.bom.gov.au/climate/drought/#tabs=What-is-drought>

Carmen, E., Fazey, I., Ross, H., Bedinger, M., Smith, F.M., Prager, K., McClymont, K. and Morrison, D. 2021 – under review, Building community resilience in a context of climate change: The role of social capital.

Helfgott, A, 2018, Operationalising systemic resilience, European Journal of Operational Research, 268: 852-864

Sauter V. (1997). Decision Support Systems: An Applied Managerial Approach. Wiley & Sons Inc., New York.

National Drought Agreement, 2018, viewed 19 August 2021, <https://www.agriculture.gov.au/ag-farm-food/drought/drought-policy/national-drought-agreement>.